TECHNICAL NOTES

LAKE STATES FOREST EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · · FOREST SERVICE

No. 627

Some Forest Overstory Effects on Microclimate and Related White Pine Blister Rust Spread [1]

White pine (Pinus strobus L.) blister rust control through eradication of the alternate host is difficult in the northern portion of the Lake States because the cool weather during wet periods favors long-distance spread from Ribes (gooseberries and currants) to white pines. It has been noted that blister rust cankers (caused by Cronartium ribicola Fischer) were less common on eastern white pine under aspen overstories than in the open and that this seemed to be correlated with low available moisture on the needles.[2]

The effect of crown covers on microclimate under the leaf canopies was investigated with the idea of using microclimates unfavorable to rust spread as an aid to control through climatic escape. The study reported here is a preliminary investigation into measurement of overstory densities, correlated microclimates, and related blister rust incidence on understory pines.

In 1959 the temperature and relative humidity under four densities of aspen were compared to those of an open grass site (with scattered pine seedlings) by locating hygrothermographs in shelters with bottoms 18 inches from the ground at each site. The accuracy of temperatures was maintained within 1° F. by matched thermometers kept in the shelters and checked weekly. Relative humidity was kept within 5 percent accuracy by weekly checks with a sling psychrometer. Each 1/100th-acre plot had about the same number of tree stems in the overstory. The plot with the heaviest density had a two-story canopy of aspen and maple, but no pine understory.

Climatic modifications caused by tree-crown covers varied with seasons. August is the most important period in the spread of blister rust from Ribes to pine. The average weather conditions from August 13 to August 22, 1959, have been chosen as an example of a typical comparison of microclimate on the aspen sites and in the open. Data obtained during 1956 to 1960 under other densities and other tree species have given similar results.

Light.--Total light (average of measurements with light meter facing north and south at breast height) decreased steadily with the subjective density of the crowns (fig. 1). Vertical light (measured by a light meter at the bottom of a vertical mailing tube at breast height) gave a fairly good correlation with subjective density.

Temperature.--Except for the shortest aspen, as crown density increased daily maximum temperatures decreased, and cool periods were generally longer (fig. 2). Minimum night temperatures were highest under medium-density crowns; under greater densities the minimum temperature decreased to equal that in the open. The lowest crown density had a net warming effect, the greatest crown density had a net cooling effect, and medium-density canopies had the effect of reducing diurnal temperature variation.

Humidity.--Except for the greatest density, relative humidities were lower and saturated air periods shorter under denser tree canopies (fig. 2). However, during periods with frequent rains it was wetter under the trees. The site with short aspen was wettest (some rain in the period). The high-density stand with a two-story canopy of aspen and maple was consistently wetter when compared to single-canopied stands. In single-canopied stands daily relative humidities were generally lower and periods of saturated air shorter as stand densities increased; exceptions occurred in some very rainy periods.

Blister rust incidence.--The number of cankers per white pine tree decreased as the density of the overstory increased (fig. 2). As would be expected in a region where temperature was generally favorable to rust spread, there was no apparent correlation with temperature. The incidence of rust on pine seemed to correlate fairly well both with periods of saturated air and with daytime relative humidity.

1/ This note is a condensation of a paper with the same title presented at the Fourth Conference on Agricultural Meteorology, Nov. 28, 1961. See Abstract in Bul. Amer. Met. Soc. 42 (1961): 739-740.

2/ Van Arsdel, E. P. Growing white pine in the Lake States to avoid blister rust. Lake States Forest Expt. Sta., Sta. Paper 92. 1961.
Also Van Arsdel, E. P., and Riker, A. J. Climatic relations of white pine blister rust. In Ann. Rpt. on Diseases of Forest Trees, Univ. Wis., pp. 5-7. 1958.

OCTOBER 1962

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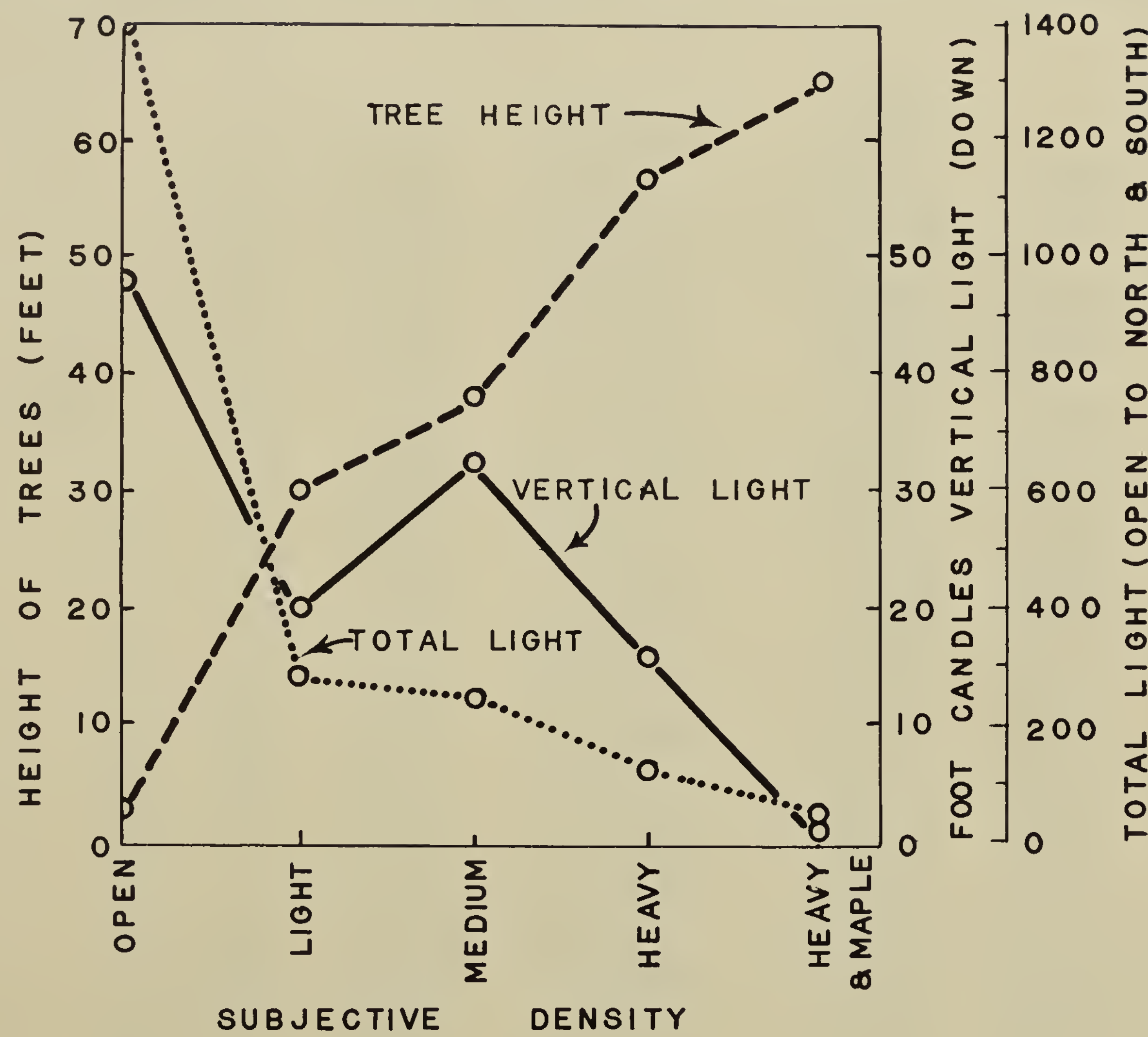

Figure 1.--Comparison of amount of light under four densities of aspen crown canopy on an open grass site. Light is inversely correlated with tree height. (In this chart, each trend line must be read against its own Y-axis. The purpose of the chart is to compare general trends rather than actual figures.)

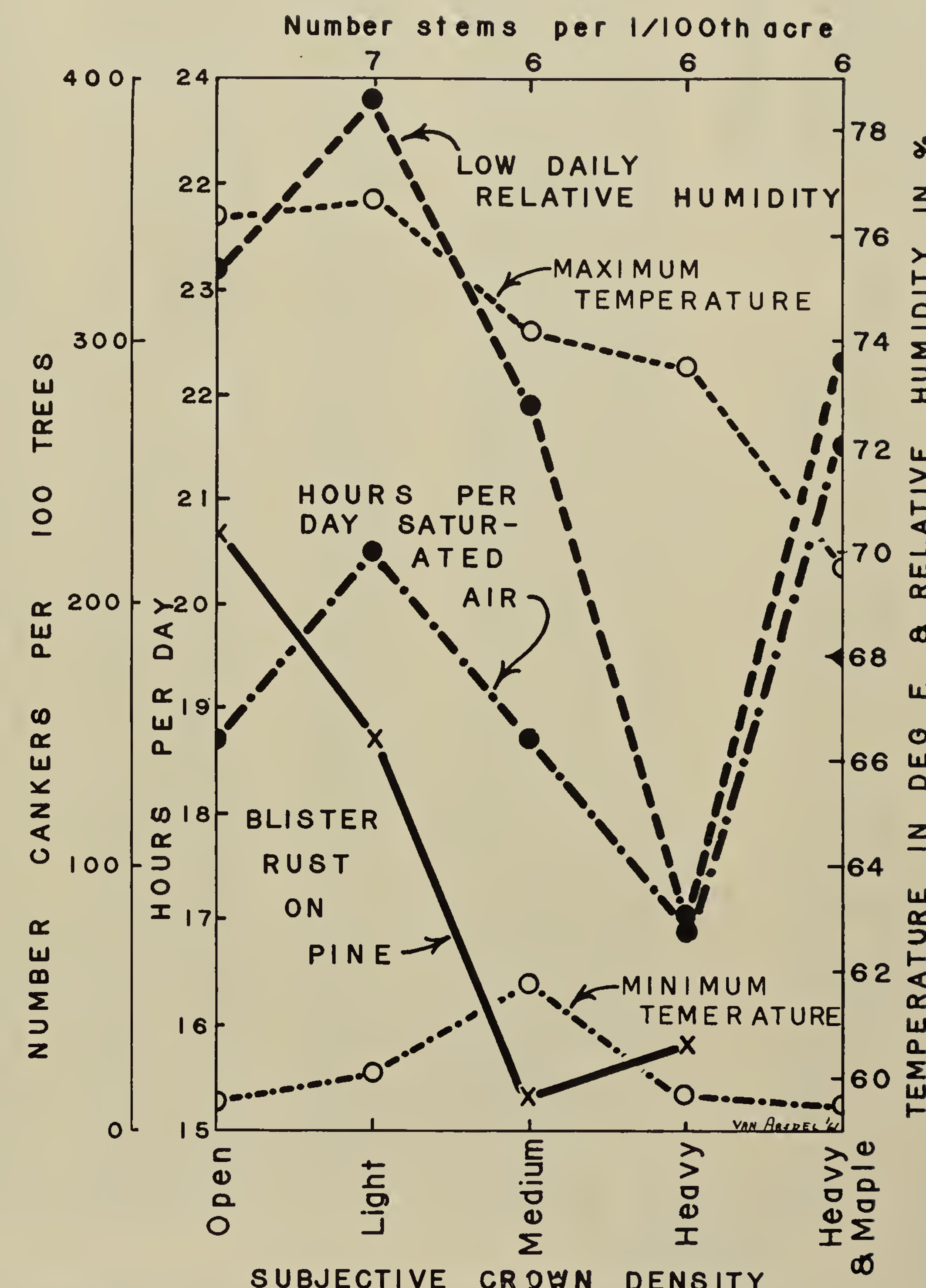

Figure 2.--Incidence of blister rust on pine compared to several meteorological factors by crown density of the overstory. (As in fig. 1, each trend line is to be read against its own Y-axis.)